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U.S. DEPARTMENT OF HEALTH
AND HUMAN SERVICES
Public Health Service
National Institutes of Health

Division of Computer Research and Technology

U.S. DEPARTMENT OF HEALTH
AND HUMAN SERVICES
Public Health Service
National Institutes of Health

Fiscal Year 1985 Annual Report
Volume I

Foreword

The Division of Computer Research and Technology has primary responsibility for incorporating the power of modern computers into the biomedical programs and administrative procedures of NIH. DCRT serves as a scientific and technological resource for other parts of PHS, and for other Federal organizations with biomedical and statistical computing needs.

DCRT programs focus on three primary activities: conducting research, developing computer systems, and providing computer facilities.

The *DCRT Fiscal Year 1985 Annual Report* describes our work in two volumes:

Volume 1 gives an overview of the work of each group, highlighting the year's accomplishments;
Volume 2 gives details about the projects and activities of each group.

From the Director

It is a pleasure to report the activities of the Division of Computer Research and Technology during Fiscal Year 1985. The report displays the remarkable breadth of DCRT interests, ability and enterprise, starting this year with the emphasis on science in the four Laboratories and moving to the emphasis on computers in the two Branches of DCRT.

Throughout the report one sees the fundamental pattern of science linked to computers through mathematics and engineering. Although details of the picture change from year to year in response to the dynamics of science and of computing, several important features are clear.

- Small personal computers used as workstations now bring more computing power and facility to the desk of the individual NIH scientist and administrator than all NIH had in its first computer in 1958. A small DCRT Personal Workstation Project begun two years ago has grown into the far-reaching efforts described by the DCRT Personal Workstation Office and discussed among the reports of all DCRT Laboratories and Branches. These many projects are linked through a functioning Local Area Network, which also connects to minicomputers throughout the Division.
- Molecular Biology, the predominant intellectual currency of biomedical research in the 1980s, has spread across computers of all sizes. Scientists sitting at terminals in laboratories throughout NIH scan, compare and analyze data on nucleic acid and protein sequences stored at the NIH Computer Center. Some scientists have begun to use the personal workstations for this. Indeed, a major scientific equipment vendor now distributes the microcomputer-based programs created by an NIH scientist.
- The most powerful and promising system exploits computers of the middle range. The DCRT Molecular and Cellular Graphics Project combines a variety of very advanced small- to medium-sized computing elements into a single system. It processes physical chemical theory and empirical data from x-ray crystallography and molecular sequencing. It presents the picture of the object under investigation rapidly to the scientists at specialized graphics terminals.
- Massive super-computers offer biomedical scientists and their administrators a vision of rapid turnaround for "computer-bound" programs. The alternative to the separate single super-computer approach is powerful specialized scalar/vector/array processors incorporated into existing computing centers or networks, or even into specific scientific processing systems when their use is appropriate. The merits of both approaches will be tested at NIH over the next few years.
- On the largest scale, the DCRT conceptual plan for future computing architecture across NIH provides a sufficient comprehensive overview amid the necessary diversity of approaches to computing throughout the NIH Bureaus, Institutes, Divisions and Offices. The outlines are clear. The power, economy and operational stability of the NIH Computer Center will be linked with workstations and local networks in two ways. One takes advantage of advances foreseen in the existing telephone technology that supports communication throughout NIH and throughout the world. The other allows for exploration of a new broadband network among NIH facilities in Bethesda.

The challenge as always is to keep up the intellectual linkage between science and computers in the scientific workplace. The NIH certainly can meet the challenge of change arising from the domains of science and computing and their intersection. The NIH approach is technically and scientifically sound, incrementally planned, organizationally robust and economically prudent. Over more than two decades it has grown and adapted to continuing challenge and change in both biomedical research and computing technology.

Arnold W Pratt, MD

Arnold W. Pratt, M.D.

DCRT Director

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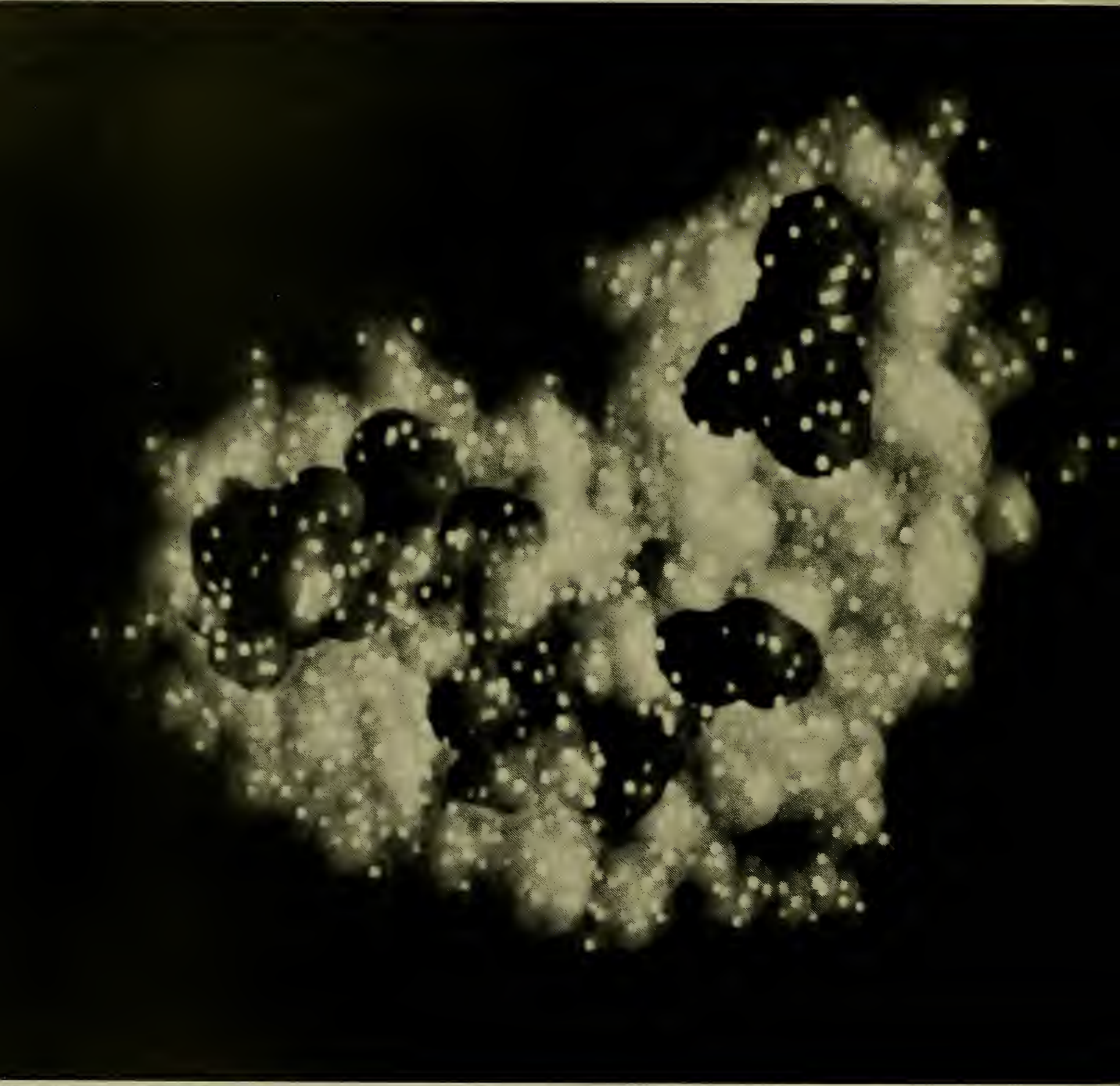
This photograph of bacteriophage T4 lysozyme was made in the course of a study on the general nature of the globular structure of protein molecules. Solid spheres represent atoms that are inaccessible to solvent; semitransparent spheres represent accessible atoms.

The image is the result of the combined efforts of D. Lipmann, NIADDK, B.K. Lee, DCRT Physical Sciences Laboratory, and R. Pastor, FDA. The graphics program was developed by S. Knisley, D. Cheung, and R. Feldmann of DCRT.



Physical Sciences Laboratory

George H. Weiss, Chief

Function and Scope of Work

The Physical Sciences Laboratory (PSL) investigates problems in the physical sciences that relate to biology and medicine. It consists of investigators with backgrounds in applied mathematics, chemistry, physics, and medicine. There are five permanent staff members and a number of visitors who come for varying periods of time. The work of the Laboratory consists both of theoretical and experimental investigations. In addition, advice is provided from the point of view of the chemist and physicist on the development of the DCRT Apollo system for molecular graphics. Approximately half of the research is self-generated and half is collaborative with other scientists at NIH and at other scientific institutions.

Some of the current laboratory projects include:

1. Development and investigation of models for nondiffusive transport on irregular media. This is heavily dependent on simulation studies and the development of theoretical models to interpret the results obtained. These theoretical results are applied to the study of dense macromolecular systems. Neutron scattering experiments have begun to determine interactions and ordering properties of macromolecules in dense solution.
2. Experiments to investigate the role of molecular forces in cellular assembly. Concurrent theory has been developed to model the interaction of large molecules by steric forces.
3. Mathematical techniques to estimate dielectric parameters for polymers and glasses. This involves accurate tabulation of stable law distributions and the development of simple approximations to experimentally accessible estimation functions.
4. Development of mathematical techniques to estimate parameters in nuclear magnetic resonance. This includes methods for the optimization of NMR experiments in the sense of measuring relaxation parameters to given precision in the shortest possible times, as well as specification of the quantities that can be used to estimate rate constants from two-dimensional NMR.
5. Experiments to determine the molecular forces that account for cellular assembly. These recently have focused on the forces due to the restructuring of water solvent between molecules. Further work is being done on measuring the work of forming aqueous cavities that can be related to the formation of ionic channels in membrane transport.
6. Experimental measurement of volume changes in the opening and closing of ionic transmembrane channels. Results of these experiments are used to decide between competing theories relating to this phenomenon.
7. Statistical mechanical studies to model the effects of geometry on the physical properties of proteins. In addition, statistical methods are used to predict secondary structure of proteins. The results will be incorporated into the Apollo system.

Many of these projects are collaborative, both within NIH and with scientists at other institutions. Neutron scattering experiments are conducted in collaboration with scientists at the National Bureau of Standards and at MIT. The work on transport in random media is conducted together with investigators at Bar-Ilan University and Boston University. Much of the work on molecular forces is done together with the laboratory of Alan Schecter in NIADDK, and the work on NMR is performed in collaboration with NHLBI. The work of Adrian Parsegian is partially supported by NIADDK, which provides laboratory space as well as two positions.

FY85 Accomplishments

Dr. Parsegian, together with Professor Evans at the University of British Columbia, has developed a theory supported by experimental evidence, for the interaction of large molecules or membranes due to the mechanical motion of bending and stretching. The results obtained from this project will be used to correlate molecular interactions and molecular conformations. Dr. Zimmerberg, together with Dr. Parsegian and others, has developed techniques to measure internal volume changes during opening and closing of ionic channels.

Mathematical techniques have been devised to estimate dielectric properties of polymer molecules whose relaxation function has the form first investigated by Williams and Watts in 1971. Both absorption and dispersion data can be analyzed using the methods developed in this project. An auxiliary result of this project is the first accurate tabulation of stable law distributions that are useful in a number of statistical applications.

A combination of simulation and theory has been used to study the kinetics of the escape of molecules from polymer and other matrices by Drs. Havlin, Nossal, and Weiss. These provide a theoretical basis for the design of drug delivery systems in which one wants specified release rates.

Techniques for computerized typesetting of scientific papers have been adapted for use on personal computers rather than mainframes. Editors of several journals have expressed interest in the methods developed in our laboratory.

Dr. Adrian Parsegian was the chairman and speaker at a tutorial symposium on Protein Insertion into Membranes at the annual Biophysical Society meeting as well as being chairman of two Gordon conferences on Membrane Transport and Chemistry at Interfaces. He is also chairman of a symposium on biocolloids at the Fifth International Conference on Surface and Colloid Science. Dr. George Weiss, together with Dr. Attila Szabo of NIADDK, organized an international meeting at NIH on Reaction Rates and First Passage Times in Chemical Physics.

Further data analysis has been performed on the occurrence of post-traumatic epilepsy in head-injured veterans of Vietnam with the interesting find that in addition to those who begin to have fits randomly (with an exponential distribution) there is a second population that begins to have epileptic fits between four and ten years post-injury.

The exact Fourier representations of probability densities for crystallographic applications have been extended to be able to analyze direct methods of phase determination. Investigation of the simplest of such methods has shown that presently used approximations can be seriously in error in the presence of atomic heterogeneity.

A method has been developed for exact calculations of survival times of particles diffusing among a set of trapping centers. This has application to problems related to the kinetics of photosynthesis as well as properties of diffusion on irregular structures such as polymer chains.

Dr. Nossal has demonstrated the applicability of neutron scattering techniques to the study of properties of dense protein solutions. These techniques will be applied to a number of specific problems within coming years.

Future Plans/Trends

Having developed a number of successful experimental techniques for the measurement of parameters that are significant in biophysics, Dr. Parsegian will apply them to several systems of practical interest. Together with Dr. Rau of NIADDK he will continue to measure forces creating and stabilizing assemblies of DNA, collagen, and other linear macromolecules. Present plans also involve use of the osmotic stress technique to obtain direct estimates of thermodynamic parameters governing nucleic acid phase transitions. The identification of mechanical fluctuations of macromolecules will be pursued both theoretically by statistical mechanical techniques and experimentally, by examining thermal factors in x-ray diffraction patterns.

The light-scattering techniques that have been perfected by Dr. Nossal will be used to examine bulk phase changes in lipid-water systems, the purpose being to understand the relationships between lipid composition and cell membrane formation. Dr. Nossal will use ideas of statistical mechanics to determine whether equilibrium calculations of structure are sufficient to describe measured properties of highly branched polymeric lattices, or whether the kinetics of the polymerization process also need to be taken into account. A further project to be undertaken involves the use of neutron diffraction to measure hemoglobin interactions within intact erythrocytes.

Dr. Zimmerberg will continue his work on the probing of ionic channels by osmotic stress, trying to correlate these data with images obtained using electron microscopy and x-ray crystallography. Further work will be done to establish the mechanism of membrane fusion. Investigations in the near future will focus on the possibility that an osmotic mechanism is the driving force for fusion.

Dr. Weiss, together with Professor Shmueli of Tel-Aviv University will continue the systematic application of exact representations of probability density functions to problems related to direct methods of phase determination. Dr. Weiss also will apply recently developed approximations to the determination of dielectric parameters from measurements of dielectric dispersion in polymers.

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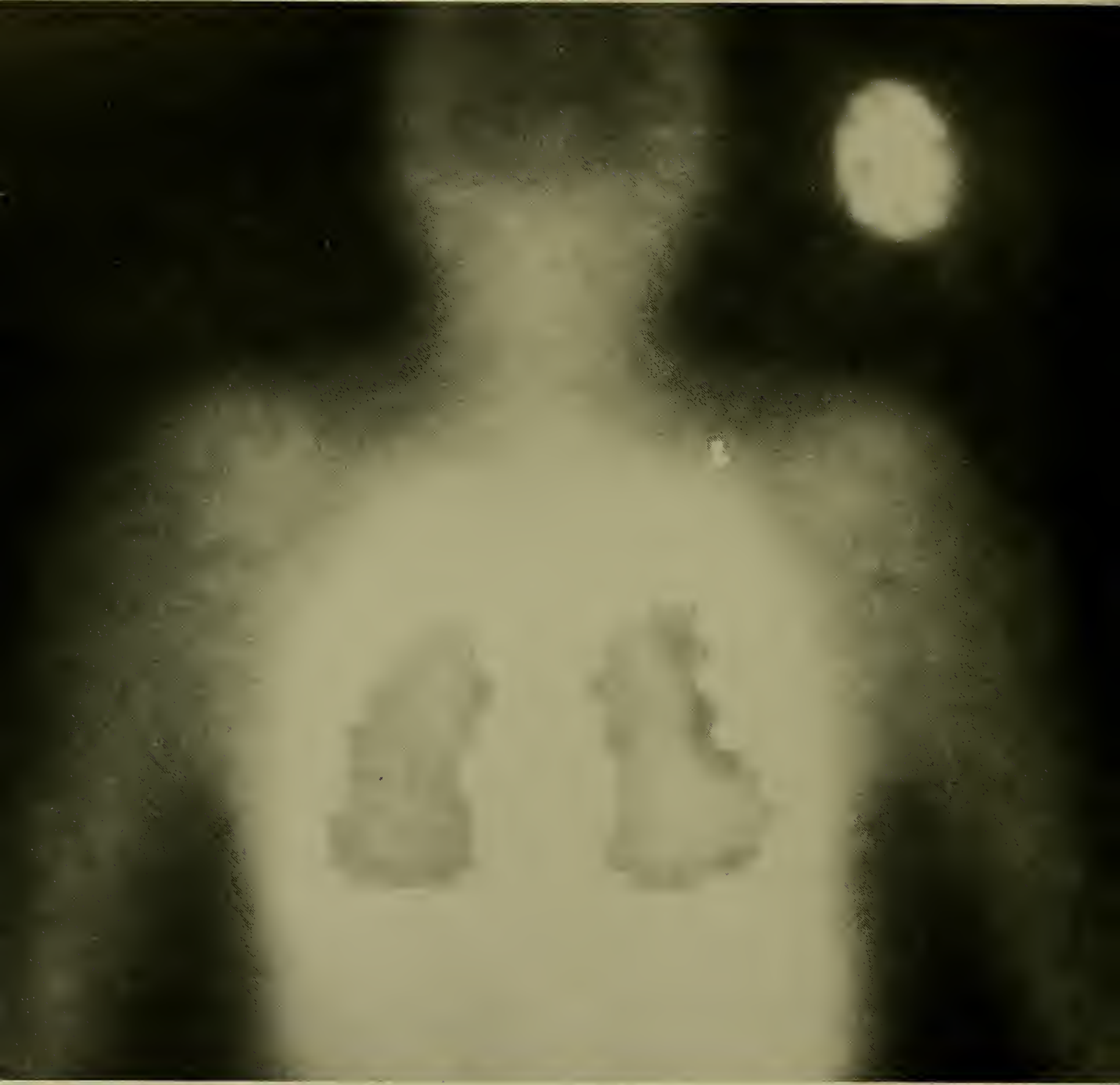
Scientific objectives of an LAS research collaboration may include advancement of diagnostic and measurement methodologies. For example, in collaboration with the NIH Nuclear Medicine Department, LAS systems analyst M. A. Douglas produced Gallium images of the lungs. These diagnostic images allow clinicians to assess severity of inflammation and to localize activity in the lung.



Laboratory of Applied Studies

John E. Fletcher, Acting Chief

Function and Scope of Work

The Laboratory of Applied Studies (LAS) is a multidisciplinary laboratory whose staff includes physicians, mathematicians, engineers, and computer scientists. LAS operates in a task-oriented mode rather than along the lines of the separate component disciplines. The majority of projects in this laboratory are direct involvements with bench scientists or clinical investigators both at NIH and at other research centers. In many cases, a project is brought to LAS by these investigators, but often LAS develops a concept within DCRT, then takes it to the Institute or other research center for implementation or further development. This laboratory's approach to research problems is to examine the underlying scientific principles, to identify the appropriate mathematical and engineering techniques, and to utilize computing systems to carry out the research objectives.

Collaborative research is therefore the primary activity of the Laboratory of Applied Studies and the multidisciplinary nature of our approach is its essential feature. Computing science is the common vehicle that integrates the various disciplines--namely basic biology, mathematical theories, mathematical models, and engineering technology. Scientific objectives of these research collaborations include: a quantitative analysis of complex interacting systems, a deeper understanding of basic physiological and pathophysiological processes, and advancement of diagnostic and measurement methodologies.

The scope of our investigations ranges from direct involvement in clinical activities, through our medical staff fellowship program, to the abstract development of numerical methods and mathematical algorithms essential to computer modeling systems that are used as general research tools. These activities are carried out administratively by two sections, the **Medical Application Section,** whose staff includes physician-scientists, electronics engineers, and computer systems analysts; and the **Applied Mathematics Section,** whose staff includes specialists in applied mathematics, computer science, biomathematics, and bioengineering.

FY85 Accomplishments

FY85 featured a slowdown in the strong progress made in previous highly productive years. The principal cause of the slowdown was a loss of 35 percent of the staff because of arbitrary position cuts, hiring restrictions, and the loss of personnel to universities and private industry.

Projects relatively unaffected by personnel changes involved the minicomputer-based laboratory system for studying delivery of oxygen to tissues during exercise. Automatic operation of the entire system, including acquisition and analysis of ventilatory flow and gas concentrations, as well as control of the bicycle and treadmill, is now possible. The systems programming is in its final stage of completion and enables computation in a turnkey manner of noninvasive indices of patient functional status and automatic reporting of collected data. Serial measurements obtained in this exercise testing laboratory provide an objective indication of severity of disease and efficacy of treatment in patients with lung and blood disorders. Dr. R. Burgess has completed a number of clinical studies, in collaboration with the NHLBI Clinical Hematology and Pulmonary Branches.

In a joint project with the Nuclear Medicine Department, LAS analyzed a large number of parameters of cardiac function to determine those that have the most power to separate normal, regionally abnormal, and diffusely abnormal groups in a test population. Application was begun of a logistic discrimination (LOGISK), developed by A. Albert while a visiting scientist at LAS, to the multiple parameters of regional function in radionuclide ventriculography; preliminary results indicate that nearly complete separation of the groups can be obtained when an optimal combination of parameters predicted by LOGISK is used.

B. Bunow and E. Pottala in a study of network languages have demonstrated that network models are uniquely useful for simulation of large-scale problems, such as arise in neurophysiology. SPICE, a widely used network modeling language, has been installed on computers of all sizes, from the IBM PC to the central IBM system. The most successful application of network modeling has been to single motor neurons, where the sufficiency of anatomical and electrical data has been established. The network representation developed for this work has been widely adopted by scientists at other institutions and within NIH.

In FY83 a collaboration was initiated with FDA physiologists to use rodent ECGs as a means of testing for cardiotoxicity of drugs and fad diets (e.g., liquid protein). The frequency content of rodent ECGs has required redesign of instrumentation and development of new ECG analysis software. The rodent heart rate of 400-600 beats per minute produces ECGs with a much higher frequency content than that found in human ECGs. The ECG software redesign was completed in FY85 and the new analysis methods have been published. Further development in this area has been slowed by the loss of technical personnel.

The LAS DeAnza image processing system is used for a wide range of image processing and algorithm development. It serves as the standard against which the IBM-XT and IBM-AT image processing systems, currently under development, are judged. It is likely to be superseded by an IBM-AT-based system when adequate software and hardware become available or are developed.

During FY85 the laboratory's project on adaptive finite elements was terminated by the loss of the principal investigator to private industry. While the existing programs (FEMOL1) are being maintained on the IBM system, their use is restricted because of the lack of experienced and knowledgeable staff. Collaborative efforts in this area will be limited in the foreseeable future.

The applied mathematics activities were particularly active in FY85. Efforts were extended in new concepts in digital filtering, root finding, floating-point standards, and singular value decomposition. These activities have resulted in several routines for data analysis and improvements in older methodologies.

Use of a personal computer as a research tool was demonstrated as the three IBM PC-XT systems evaluated in FY84 were integrated into ongoing laboratory projects. The personal computers were used both as computers in the strictest sense, and as "ridges" between various other computer systems, allowing work done on one system to be passed through the personal computer as a common link to another system. The determination was made that the standard personal computer configuration supported by DCRT through the Personal Workstation Office is not adequate to support physiological imaging, and so an additional, more powerful system has been obtained to be developed as an imaging system. Laboratory personnel continued to serve as expert consultants in various areas of personal computer usage through the PWO for DCRT and NIH as a whole.

During FY85 LAS staff members participated in various teaching and consulting, or advisory activities.

R. Shrager continued to serve as consultant to NIH biochemists, in areas of numerical methods. He was particularly active this year in both collaborative projects and independent investigations. He was an instructor in the Foundation for Advanced Education in the Sciences (FAES) graduate school, and a lecturer within DCRT and at the Chesapeake Microcomputer Club.

J. Fletcher continued to serve as Chairman of the Mathematics and Computer Science Departments of the FAES. He currently is serving on a planning committee for the Deputy Director of Science, NIH, to study and to make recommendations on the future of modeling software and collaborative scientific support for NIH intramural science.

J. Bailey continued as a consultant on Common Standards for Quantitative Electrocardiography, a program in medicine and public health, sponsored by the European Economic Community and also as a member of the American Heart Association Committee on Electrocardiography and Cardiac Electrophysiology. He is cochairman of the AHA Subcommittee on Computers and Electrocardiography.

Future Plans/Trends

The logistic discriminant program LOGISK will be used to determine the optimal combination of parameters in radionuclide ventriculography that can separate normal, diffusely abnormal, and regionally abnormal cases. After such a combination has been determined for a training set of cases, it will be validated with a larger test set. A successful test will lead to a refinement in the noninvasive, differential diagnosis of coronary artery disease and cardiomyopathies.

In cooperation with the Department of Critical Care Medicine, CC, a project to investigate neurologic function in patients with alteration in mental status has moved from the hardware acquisition stage to the software development stage. Several methods for analysis, tracking, and display of evoked potentials are under investigation. After testing on simulated data is completed, various indices derived from the electrophysiologic data will be correlated with other independent measures of cerebral function both in ICU patients and in dogs. The results will be utilized to develop a totally noninvasive and automatic determinant of central nervous system functional status.

The aging MAC-16 will be replaced with an LSI-11-based system including an updated array processor. The rodent ECG analysis systems will be moved to the LSI-11 system to permit faster interactive processing and reduce data processing costs.

With the departure of Dr. B. Kamgar-Parsi, research on the constrained minimization software and the multivariate root-finder will be continued by R. Shrager. The arrival of the FPS array processor will provide an additional tool for numerical analysis in multivariate areas with expanded emphasis on large problems. The areas of root-finding, filtering, and singular value decomposition are expected to remain very active.

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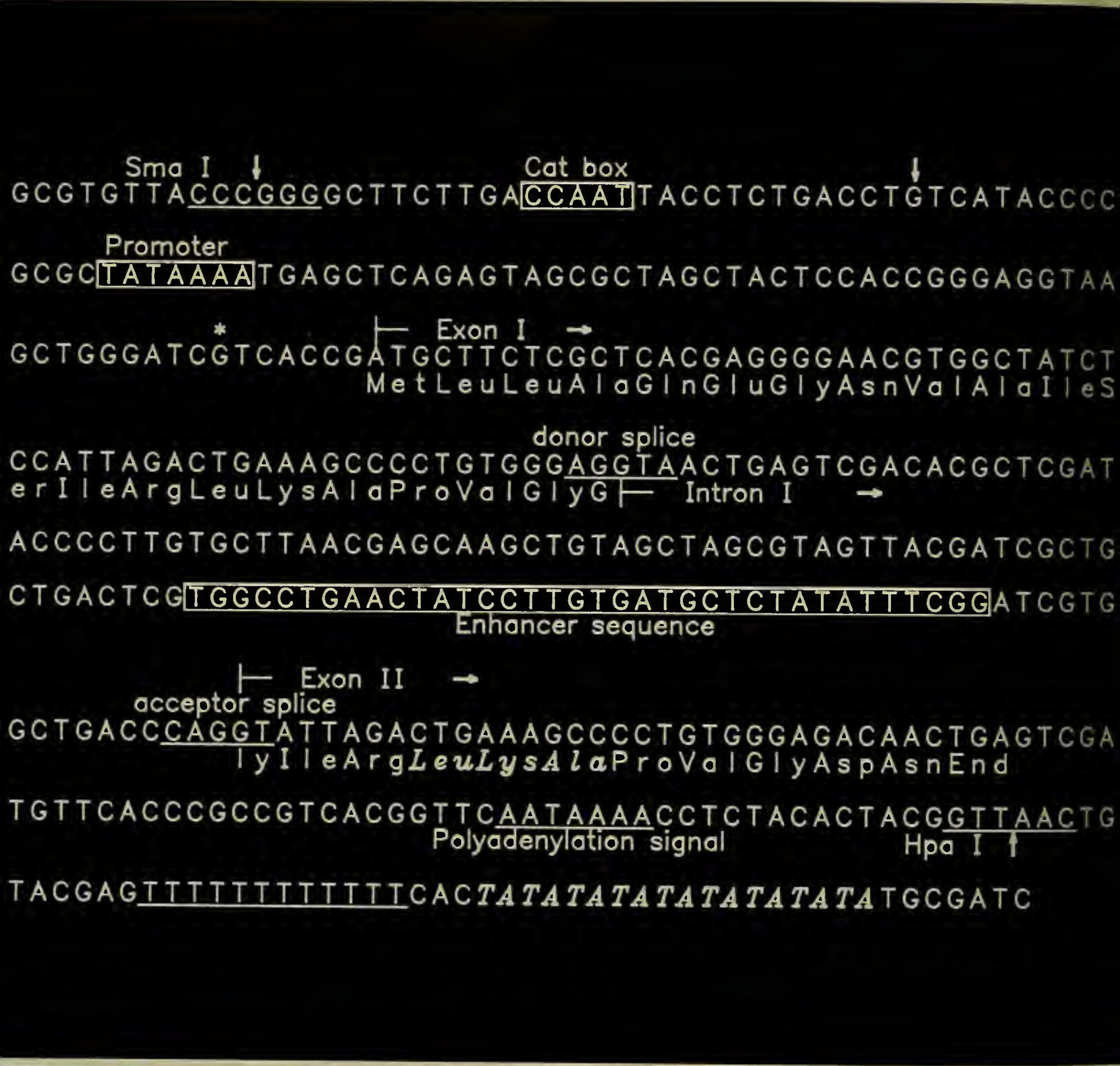
DNA:DRAW enables researchers to use the computer to produce publication-quality drawings of DNA sequences, with complicated annotations and highlighting. The program was developed by Marvin Shapiro and Peri Senapathy of DCRT.



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     Sma I   ↓                   Cat box                 ↓
GCGTGTTACCCGGGGCTTCTTGACCAATTACCTCTGACCTGTCATACCCC

    Promoter
GCGCTATAAAATGAGCTCAGAGTAGCGCTAGCTACTCCACCGGGAGGTAA

          *      ├─ Exon I   →
GCTGGGATCGTCACCGATGCTTCTCGCTCACGAGGGGAACGTGGCTATCT
                 MetLeuLeuAlaGlnGluGlyAsnValAlaIleS

                         donor splice
CCATTAGACTGAAAGCCCCTGTGGGAGGTAACTGAGTCGACACGCTCGAT
erIleArgLeuLysAlaProValGlyG├─ Intron I    →

ACCCCTTGTGCTTAACGAGCAAGCTGTAGCTAGCGTAGTTACGATCGCTG

CTGACTCGTGGCCTGAACTATCCTTGTGATGCTCTATATTTCGGATCGTG
                     Enhancer sequence

           ├─ Exon II   →
      acceptor splice
GCTGACCCAGGTATTAGACTGAAAGCCCCTGTGGGAGACAACTGAGTCGA
           lyIleArgLeuLysAlaProValGlyAspAsnEnd

TGTTCACCCGCCGTCACGGTTCAATAAAACCTCTACACTACGGTTAACTG
                     Polyadenylation signal      Hpa I ↑

TACGAGTTTTTTTTTTTTTCACTATATATATATATATATATATGCGATC
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Laboratory of Statistical and Mathematical Methodology

James E. Mosimann, Chief

Function and Scope of Work

The Laboratory of Statistical and Mathematical Methodology (LSM) combines research in mathematical statistics, mathematics, and computer and information science with collaboration and service in these areas to NIH researchers and administrators. LSM staff interact with all NIH Institutes, with other Federal agencies outside HHS, and with biomedical researchers worldwide.

In addition to the position of chief, the laboratory has fourteen full-time professional positions distributed among four sections:

- The **Statistical Software Section** (SSS) provides consultation to and collaboration with NIH researchers and administrators in all computational aspects of biomedical data analysis, including selection and support of large systems/packages. Three specialists in scientific programming are led by a computer systems analyst whose specialty is statistics.
- The **Statistical Methodology Section** (SMS) works closely with the Statistical Software Section. Three professionals in mathematical statistics, assisted by a computer systems analyst, provide biostatistical consultation and do independent research.
- The **Biomathematics and Computer Science Section** (BCS), directed by a mathematician, performs independent research and provides consultation and collaboration in the specialties of its three computer and mathematical scientists. (One computer analyst is currently on assignment outside LSM.)
- The **Medical Information Science Section** (MIS) investigates and develops methods for application of information and computer science to medical language data processing. Two computer specialists work under the direction of a computer systems analyst who is an expert in computational linguistics.

A major part of LSM activity is the offering of statistical and mathematical systems/packages to the NIH user community. LSM accepts responsibility for evaluation of new systems/packages and their suitability for NIH. When it offers a system/package to the NIH community, LSM makes three basic commitments:

1. Maintenance of the package, with adequate documentation, through NIH computer system changes, system/package updates, and corrections.
2. Rapid response to queries concerning user access to a system/package program, including job control language and program parameters.
3. Assistance in interpretation of results.

As a result of LSM's policy of not only supporting the use of these systems/packages but also aiding in the interpretation of their output, the statisticians of the Statistical Methodology Section provide consultation over a wide range of scientific fields. Some very brief consultations are very successful because there is a known answer to the question at hand. Other consultations involve extensive time and statistical/mathematical/computer science research as well.

Research projects in LSM vary widely from studies of natural language processing for medical information systems and studies of computer graphics and scientific text to studies in mathematics and statistical methodologies for biomedical applications.

FY85 Accomplishments

This was LSM's eleventh year as a separate entity within DCRT. The volume of its computational and consultative services continued to expand. Its research activities remained at about the same level.

Consultation, Collaboration, and Research

LSM consultation and research was closely tied to the use of the computer. Most consultations (55 percent) involved statistical advice combined with considerable computer use. Others (40 percent) involved computer use alone and a small fraction (5 percent) involved mathematical or statistical advice with only limited computer use. These percentages are unchanged from FY84.

LSM research, collaborative, and consultative efforts were expressed in a number of studies. Statistical methodologies were developed for, or modified to suit, specific biomedical problems.

Studies of discriminant methods continued in collaboration with Dr. J. Darroch, Flinders University, South Australia, and a paper has been accepted for publication.

Further results have been obtained for the problem of optimally estimating the variance components in an analysis of variance. These new methods now are shown to be ring-theoretic in nature as well as simple to calculate. This underlying algebraic nature of the solutions represents also a new body of technique in the statistical literature, and hence promises a new avenue of research in mathematical statistics generally. The collected material is presently being brought together in a book, and will provide a complete overview of the unbiased estimation of variance components as well as help mediate the introduction of algebraic structural methods into the statistical literature.

Collaborative work was completed with Dr. G. Crabtree (NCI/DCBD/LP) on the evolution of the three fibrinogen genes. Several probabilistic models were constructed to deal with the problem of data, which by the nature of the problem is inaccessible to the researcher. Specifically, the pattern of present or absent introns on the genes was studied in an effort to determine the historical development of the genes, and one class of observations is that for which an intron is absent on all three genes, its presence thus being indetectable on the present day genes. The results are in press for the *J. of Molecular Biology*.

A study of nonparametric methods for simultaneously comparing more than two treatment groups was completed. A paper on new methods for multiple comparisons in collaboration with Dr. J. Skillings (Miami Univ., Ohio) has been accepted for publication. An evaluation of tests for correlated proportions with incomplete data is ongoing. New aspects of the study of data with correlated proportions were initiated using models incorporating Dirichlet distributions. A new study of weighted U-statistics for the analysis of ranked data was initiated.

A collaborative study with Dr. S. Schein (NEI/CB) and Dr. F. Monasterio (NEI/LVR) of the spatial distribution of blue cones in the retina was completed, and a paper was accepted for publication. A study involving cluster analysis of cell sorter data was initiated with Dr. J. Wunderlich (NCI/DCBD/I) and Ms. J. Titus (NCI/DCBD/I). The location of clusters of types of cells is being studied using multivariate data.

Also, studies of "size and shape" variables were continued. These studies provide methods for studying random proportions or ratios of common occurrences in biomedical data. Models for mixtures of proportions were analyzed, and programs computing maximum likelihood estimates were implemented in PL/I on the S/370 for possible inclusion as specialized procedures in SAS.

In computer science, work is continuing on methods of computer generation of scientific text and graphics. It is expected that results of this research will be incorporated in an expanded version of VMAP when more advanced laser printers become available at NIH. A project on information storage and retrieval was terminated, with the retirement of the principal investigator. Studies of use of intelligent terminals to enhance performance of graphics workstations continued. Mathematical research continued, including studies of inclusion relations for vector spaces and modules and for structure of Boolean algebras.

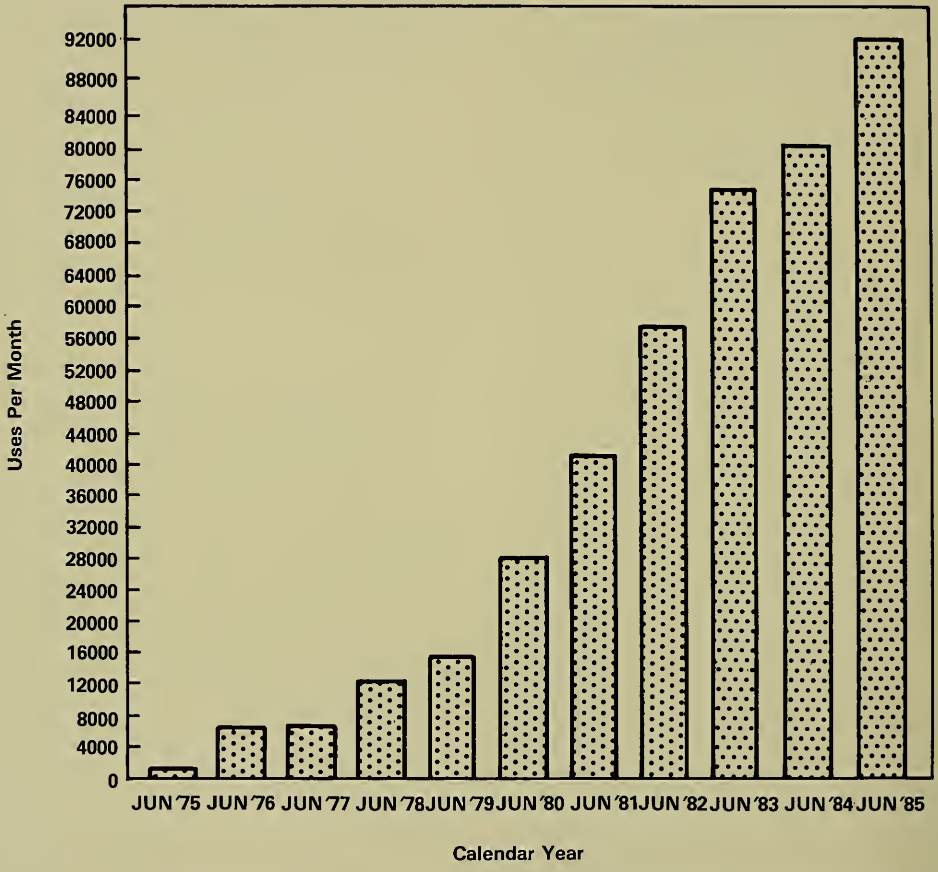
Research in medical linguistics continued, including the establishment of compositional lexical semantics of medical terms and the development of a comprehensive lexicographic data base for the modeling of categorized nomenclatures.

Collaboration continued with the Laboratory of Pathology, NCI, and the DCRT Data Management Branch to maintain and improve the data base of Clinical Center surgical pathology reports. The automatic encoding system developed by MIS uses multiple word or phrase matching and other techniques to encode English pathology diagnostic statements into SNOP, the Systematized Nomenclature of Pathology. The encoding programs were updated by incorporating a new theory of syntax for diagnostic noun phrases developed earlier within MIS. This has resulted in an improved precision of encoding.

Collaboration also continued with Dr. D. E. Henson (NCI/DCPC/CORB) in specific areas of construction of the encoding dictionary, and with Dr. E. Jaffe (NCI/DCBD) on the lymphoma vocabulary.

Work also continued on the creation of a comprehensive lexicographic data base relating the body of medical nomenclature and vocabulary to itself and to existing coding systems. Goals are the semiautomatic display of relevant relationships of one dictionary system to another, the merger of dictionaries, and construction of medical microglossaries for medical language data processing.

Statistical Packages Supported by LSM*



*Packages supported by the Statistical Software Section only. Does not include packages supported by the Biomathematics and Computer Sciences Section.

Computation

During this year, the Statistical Software Section of LSM maintained the following systems/packages and programs on the IBM System 370 of the DCRT Computer Center:

- BMDP, BMDP Statistical Software, Inc.
- SPSS, SPSS-X, and SCSS, Statistical Package for the Social Sciences, SPSS, Inc.
- SAS, SAS/GRAPH, SAS/ETS, SAS/OR, SAS/FSP: SAS Institute, Inc.
- P-STAT Statistical Package, P-STAT, Inc.
- IMSL, International Mathematical and Statistical Libraries, IMSL, Inc.
- MSTAT1, Collection of Mathematical and Statistical Programs, DCRT.

The SSS staff responded to over 8,500 queries concerning use of these packages. Also during this year, PSTAT went through a major update.

The Biomathematics and Computer Science Section maintains several systems/packages and specialized systems on the DECsystem-10 of the Computer Center. Foremost in use is the interpretive system MLAB, designed (by LSM scientists) for biomathematical modeling, for cluster analysis, and for computer graphics. BSC released a computer software package called VMAP for simplified computer generation of scientific text using WYLBUR and the IBM 6670 laser printer on the S/370.

LSM stresses the importance of teaching the effective use of systems/packages to the biomedical scientists and other users of DCRT.

LSM taught and maintained documentation for supported systems/packages. LSM taught eight introductory courses for SAS, two for SPSS, two for BMDP, three for SAS/GRAPH, one for VMAP, and offered a half-day seminar in PSTAT. One beginning and one advanced course were taught on MLAB, along with special courses: MLAB modeling for chemical kinetics and equilibrium, and C-LAB operators in MLAB for cluster analysis. New MLAB documentation distributed included the *MLAB Reference Manual,* eleventh edition, the *MLAB Beginner's Guide,* third edition, and the *MLAB Applications Manual,* fourth edition. The *VMAP 3.2 Reference Manual* is being printed as this annual report goes to press.

The GRAPH system for computer generation of data graphs has continued to get heavy use. Program enhancements made during FY85 include: adding seven new fonts and the necessary software to fill in and smooth characters of any size, and allowing titles in the middle of a shaded area. Four courses on GRAPH were taught, and a fourth edition of its reference manual was produced and distributed.

In a separate but related development, a new program--DNA:DRAW--was released for NIH users. This program enables researchers with no computer background to produce publication-quality drawings of lengthy DNA sequences by computer. Three courses have been taught in DNA:DRAW, and its use is growing rapidly.

Future Plans/Trends

No major shift in laboratory service or research is anticipated in the coming year. However, decrease of MLAB consultative support is anticipated due to retirement of the senior author this year. Otherwise, current levels of systems/packages support, consultation and user assistance will be maintained. Increased effort for development and support for VMAP is expected. Research projects will be continuations of current research.

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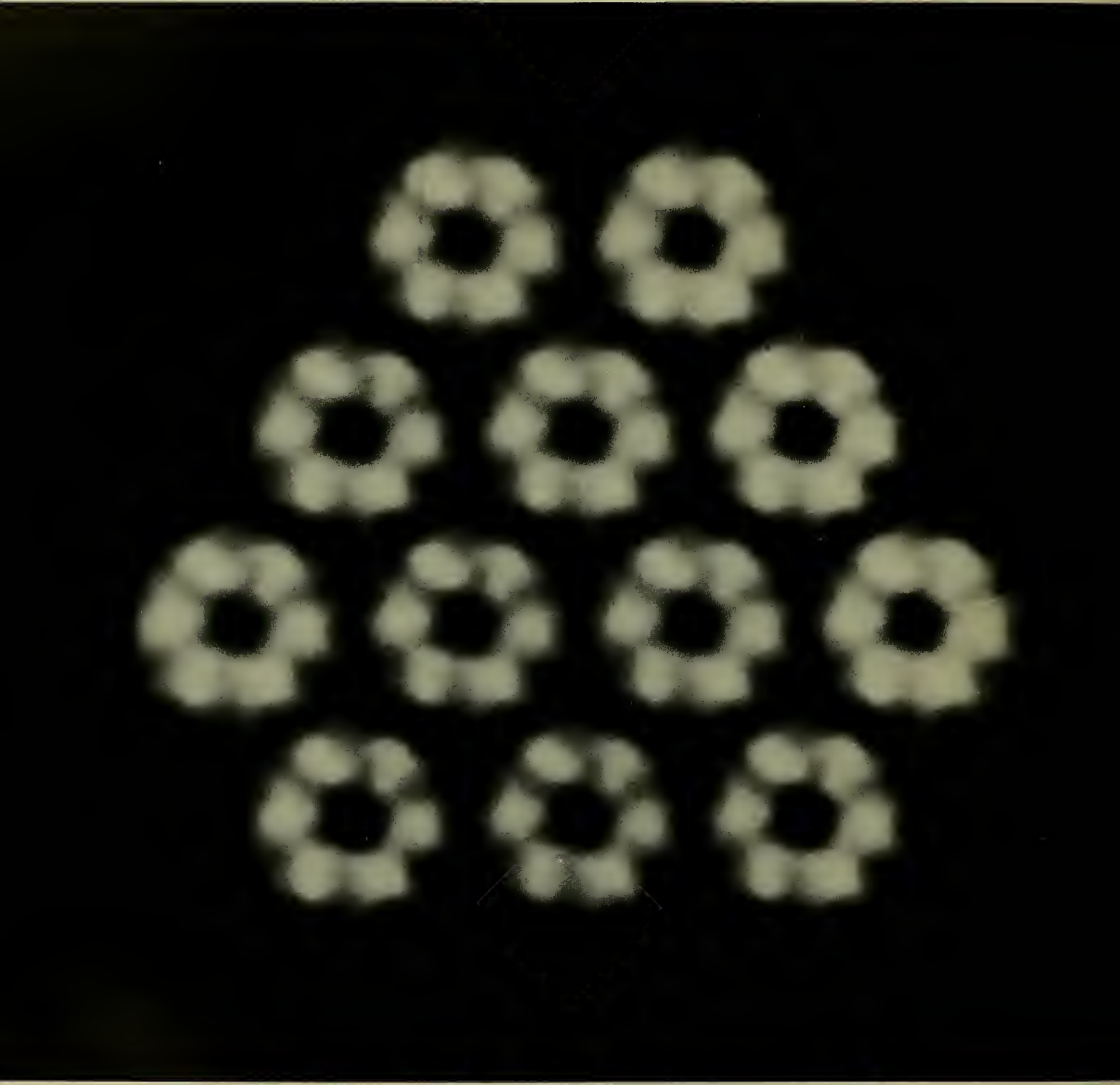
Dr. Benes L. Trus uses image processing to examine macromolecular structure. This photograph shows the high resolution structure of one facet of the icosahedral capsid of herpes simplex type II virus, obtained by processing electron micrograph images. The methodology was a collaborative effort of three groups at NIH—the Computer Systems Laboratory, DCRT, the Laboratory of Cellular and Developmental Biology, NIADDK, the Biomedical Engineering and Instrumentation Branch, DRS—and the Microbiology Department at USUHS.



Computer Systems Laboratory

Alan M. Demmerle, Chief

Function and Scope of Work

The Computer Systems Laboratory (CSL) develops and implements special purpose computer systems. Its staff contributes expertise in engineering, computer science, mathematics, chemistry, and medicine. The Laboratory's program consists of three main parts:

- Collaboration with biomedical scientists on multidisciplinary research and development projects in laboratory automation and patient care that require the application of computer technology.
- Internally generated research and development into new applications of computers to biomedical research; identification of appropriate technology for these applications; and development of systems that benefit communities of users.
- Consultative support for all segments of NIH on data acquisition, laboratory computing, and computer communications.

Most CSL projects are involved with intramural scientific or clinical research. However, laboratory staff members are frequently asked to provide consultative assistance to extramural programs, and occasionally to other agencies or nongovernment centers. The laboratory's work usually centers on systems based around minicomputers or microcomputers, or on computer-related technologies, such as data communications, where substantial engineering contributions are required.

This year, CSL worked on 25 projects representing collaboration with almost all NIH institutes and divisions, as well as another 7 internally generated research and development activities. Most of these were carried over from previous years; 6 projects were begun this year.

FY85 Highlights

This year saw an increase in the use of personal computers in laboratory and clinical investigations. In one such application, CSL collaborated with investigators in NHLBI's Cardiology Branch to develop a system to replace manual methods for computing cardiac venous blood flow during cardiac catheterization.

The catheterization laboratory employs a thermodilution technique in which a cold saline solution is infused through a catheter into the coronary venous system. The catheter, which has two thermistors positioned near its tip, is inserted so that the proximal thermistor senses blood temperature within the coronary sinus and the distal thermistor senses blood temperature within the great cardiac vein. The cold saline mixes with blood as the solution travels downstream past the thermistors. Because heat gained by the saline solution must equal heat lost by the blood, flow can be determined from a calculation involving the initial temperature and rate of injection of the saline solution and the change in temperature of the blood-saline mixture. The thermistor electronics produce varying DC voltages proportional to temperature. CSL interfaced these signals to the computer's analog-to-digital converter and programmed the computer to acquire temperature data automatically and then to calculate and display coronary venous blood flow.

Formerly, technicians measured temperatures from strip chart recordings, then manually calculated flows, usually after a case was completed. With the computer, results are available immediately "on-the-fly" during a case. Often, this uncovers problems that might otherwise have gone unnoticed until flows were calculated after the case, thereby allowing their correction, preserving valuable data, and saving time. In drug intervention studies, the computer gives the investigator the data he needs to tailor or modify a case in progress. Time for a catheterization procedure sometimes is reduced by as much as 20 percent.

Although a relatively simple application, this system illustrates the ability of a small, inexpensive computer to make fast, repeatable, accurate measurements. It saves valuable investigator and technician time and reduces the time that a patient must be subjected to an invasive procedure.

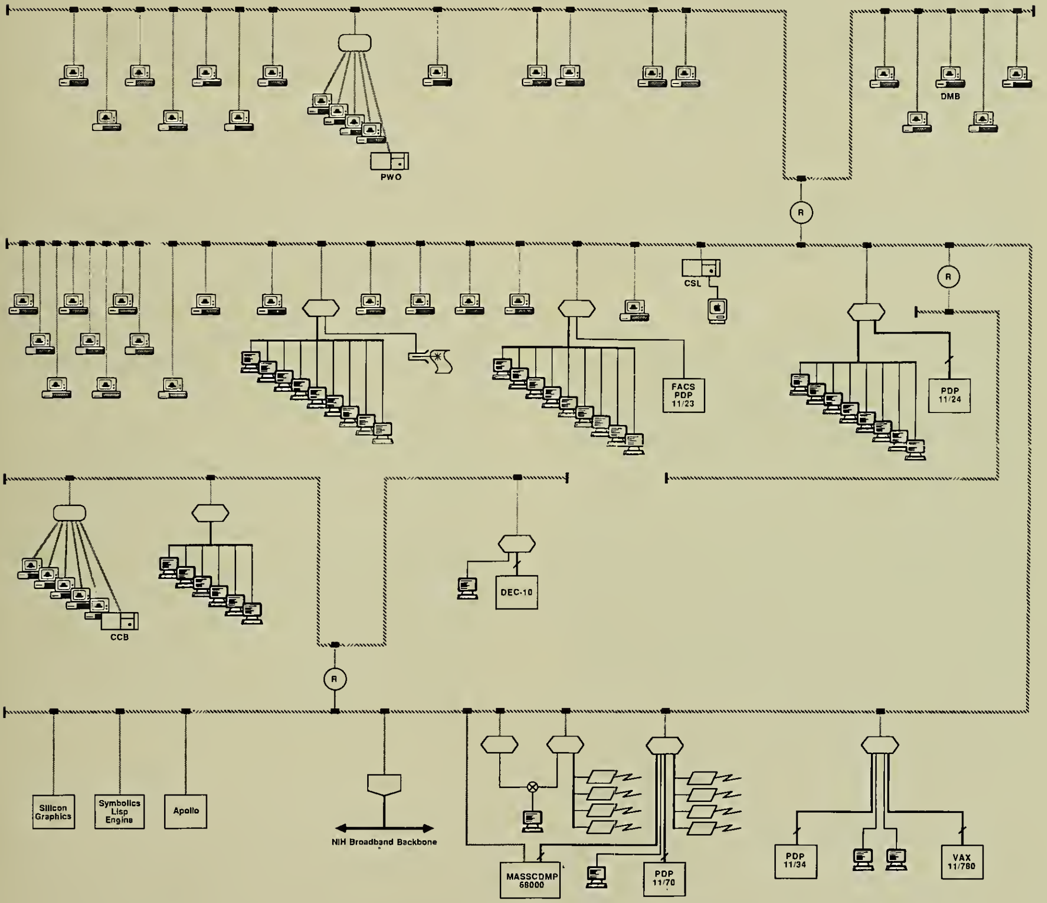
In a project with NIADDK investigators, CSL modified and extended a commercial software product so the investigators could easily alter their data acquisition and control procedures. The investigators needed a flexible language system suited to laboratory data acquisition that permitted them to quickly adapt programs to new experimental protocols in retinal metabolism research while retaining high-speed data acquisition capability. Ultimately, CSL selected the Data Acquisition Operating System (DAOS) from Laboratory Software Associates of Melbourne, Australia as the most suitable to NIH requirements. The software package was added to the Arthritis Computer Facility (ACF) that CSL had previously developed. Among the major strengths of DAOS are its interpreted realtime control language and its extensibility. The latter enabled CSL to incorporate features for stepping motor control and for counting and timing into DAOS as extensions of the language itself.

The value of DAOS to the investigator lies in the rapidity with which new programs may be written or changes made to an existing control program. In addition, DAOS permits analysis programs already available on the ACF to be used for analyzing data collected using DAOS.

A new initiative this year, which is at once a collaborative project and an example of internally generated research, concerns the development of "expert systems" in the medical environment. Expert systems are present-day, feasible applications of artificial intelligence techniques that form the centerpiece of the much publicized fifth generation computer systems of the future. They are knowledge-based in that they contain knowledge contributed by experts and organized by "knowledge engineers." Generally, they function best in specific, narrowly defined, yet still complex, problem areas.

Possible medical areas for the application of expert systems include physical diagnosis, therapy planning, and clinical data interpretation. An initial objective for the project is to develop, in collaboration with the Critical Care Medicine Department of the Clinical Center, an Intravenous Chemotherapy Advisor Expert System for use in an intensive care unit. The specific problem of interest is drug therapy to stabilize cardiodynamic function. Longer range objectives include the investigation of languages and personal computing technology for implementation of expert systems, development of techniques for this relatively new field, and application of expert systems technology to other appropriate areas such as office automation.

DCRT ETHERNET



CSL involvement with local area networks (LANs) began in FY84 with the installation of an Ethernet in Building 12A. This year the network has been extended to Buildings 12 and 12B. It now spans 1250 meters of cable and interconnects 45 personal computers and five host computers. Primarily, the network provides a simple way for programmers and engineers to access a variety of computers with a single physical connection to the cable, and DCRT staff are beginning to use other network features such as electronic mail.

CSL is pursuing networks further by providing technical leadership for a survey of networking requirements at NIH. In particular, transmission of medical data and images, interconnections of individual LANs, and very high-speed communications among host computers are under consideration.

Proposed Course

Because CSL has been so severely affected by recent reductions in personnel ceilings, future priorities will give greater emphasis than in the past to problem areas and technical approaches that appear to have wide impact on biomedical science at NIH.

For example, to accommodate the increasing use of personal computers in NIH laboratories, CSL expects to set up a group to support laboratory applications of PCs. Traditionally, CSL either has collaborated with, or has provided support to, investigators whose research required the use of computers in laboratory or clinical situations. Personal computer applications, because of their sheer numbers, prevent us from doing this in every case. Instead, members of the CSL team will offer advice on system configuration, suitable laboratory software packages for particular applications, and hardware interfacing equipment and techniques. A major thrust of this project will be to try to characterize applications as they come to CSL's attention, to develop consistent approaches to these applications, and to develop solutions for commonly encountered problems that cannot be solved with commercial products.

PCs, no matter how valuable, cannot solve every laboratory problem, so a new "Advanced Laboratory Workstation" is also planned. Recently-developed 32-bit microprocessor architectures have evolved to the point that computing power previously reserved for central computing facilities is now cost-effective in the laboratory. CSL hopes to develop a workstation that combines this computing power with data acquisition, display, data management, and communications--in short, a complete laboratory computing environment for scientists with demanding requirements.

Another planned initiative to respond to personnel ceiling reductions is increased use of contractor assistance. For several years CSL has employed, to a relatively limited extent, contractor-supplied support services for computer programming. In the future, the use of such services will be increased in quantity and broadened to a wider range of service and support functions. Of course, to the extent these services directly support collaborative or consultative projects, other B/I/Ds will be asked to bear the costs, just as they are now asked to bear the cost of computer hardware and software.

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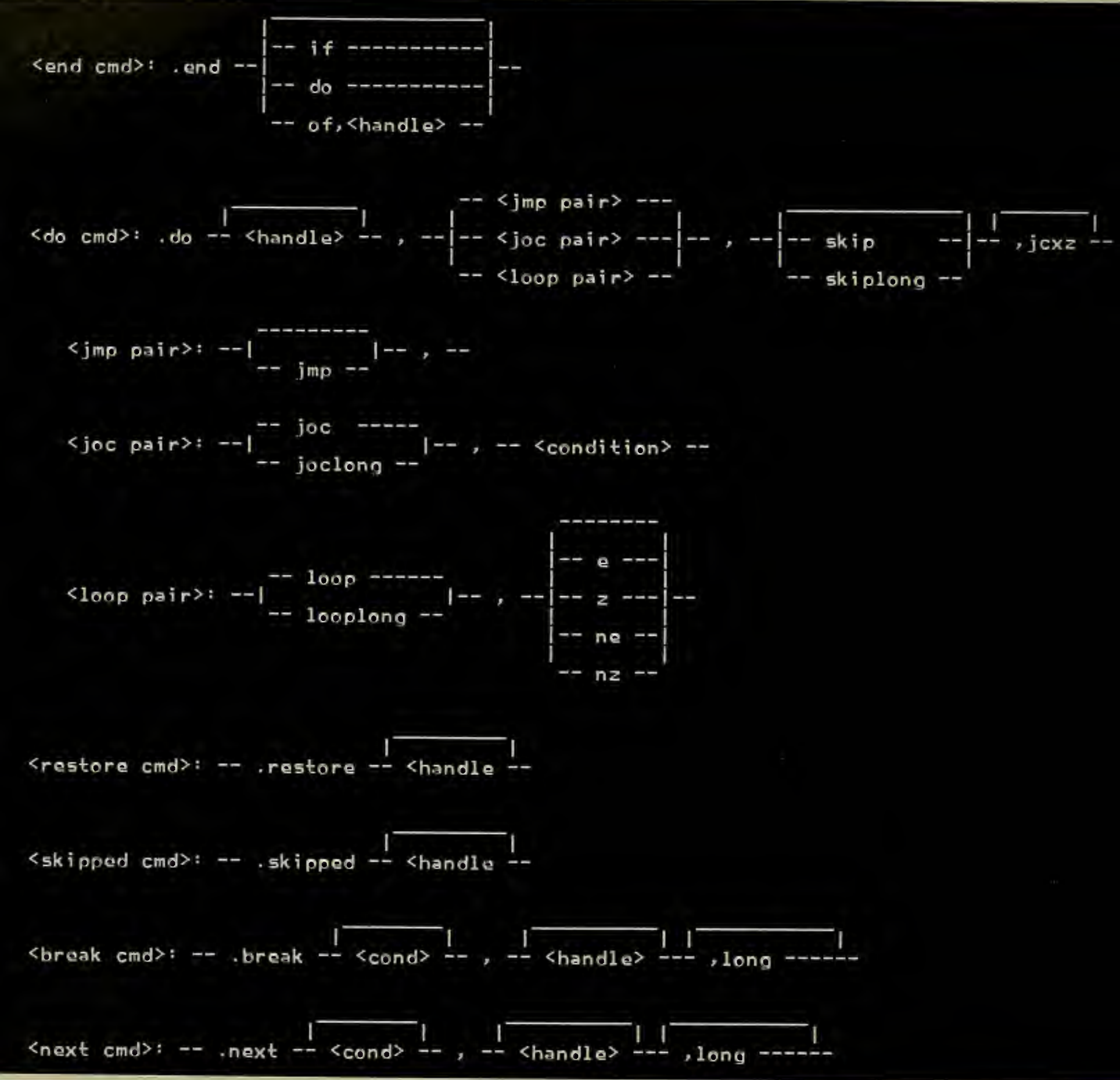
Software developer Robert A. Magnuson has created a tool known as SASM, a macro library that implements structured programming. SASM assists IBM PC macro assembly language programmers by generating block-structured programs.



```
                   _________________
                  |                 |
                  |-- if -----------|
<end cmd>: .end --|                 |--
                  |-- do -----------|
                  |                 |
                   -- of,<handle> --


                                  -- <jmp pair> ---
                ___________                                  ______________  _________
               |           |     |                 |       |              ||         |
<do cmd>: .do -- <handle> -- , --|-- <joc pair> ---|-- , --|-- skip     --|-- ,jcxz --
                                 |                 |       |              |
                                  -- <loop pair> --         -- skiplong --


                  ---------
   <jmp pair>: --|         |-- , --
                  -- jmp --

                  -- joc  -----
   <joc pair>: --|             |-- , -- <condition> --
                  -- joclong --


                                          --------
                                         |        |
                                         |-- e ---|
                   -- loop ------        |        |
   <loop pair>: --|              |-- , --|-- z ---|--
                   -- looplong --        |        |
                                         |-- ne --|
                                         |        |
                                          -- nz --


                             _________
                            |         |
<restore cmd>: -- .restore -- <handle --


                             _________
                            |         |
<skipped cmd>: -- .skipped -- <handle --


                         ________       __________   ___________
                        |        |     |          | |           |
<break cmd>: -- .break -- <cond> -- , -- <handle> --- ,long ------


                       ________       __________   ___________
                      |        |     |          | |           |
<next cmd>: -- .next -- <cond> -- , -- <handle> --- ,long ------
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Data Management Branch

J. Emmett Ward, Chief

Function and Scope of Work

The Data Management Branch (DMB) provides advice and assistance to research investigators, program officials, and administrators throughout NIH in planning for and obtaining computer data processing services. In this role the branch is a central NIH resource for systems analysis, design, and programming. The Branch is also responsible for the development, maintenance, and processing of the NIH Administrative Data Base and the Clinical Center's Clinical Information Utility. There are currently 48 permanent full-time employees whose disciplines include computer science, mathematics, and statistics.

DMB staff design and create computer-based data management systems that provide practical solutions to the unique mix of administrative, scientific, and management data processing problems encountered at NIH. Each new computer system user is provided comprehensive training in all system facilities and functions of the system provided by DMB. In addition DMB staff teach courses about programming tools; provide advice on data management techniques to NIH programmers; serve as consultants to the B/I/Ds for obtaining and monitoring contracting services for computer systems development; and create and maintain general purpose, user-oriented programming tools to speed building and improve operation of applications systems.

DMB comprises four sections. **The Applied Systems Programming Section** (ASPS) and the **Scientific Applications Section** (SAS) provide general computer systems analysis and programming services for all of the B/I/Ds. The ASPS supports general data management, and the SAS handles those projects that require scientific data analysis.

The **Data Base Applications Section** develops and maintains the central administrative data base for NIH materiel and financial management. The **Clinical Support Section** develops and maintains the Clinical Information Utility as a data base for research and patient care in the Clinical Center.

FY85 Highlights

This fiscal year, Data Management Branch worked on over 45 projects, both large and small.

One large project is an ongoing developmental effort known as the Administrative Data Base (ADB), which uses data base technology in support of NIH-wide materiel and financial mangement. Progress to date has seen major improvement in:

1. the control of central and delegated ordering, receiving, and payment procedures
2. full automation of stock requisitioning, central and self service stores inventories
3. the elimination of 100 percent of delegated and over 75 percent of central paperwork and paper flow, and
4. the replacement of intermediate data collection procedures by electronic data transfer.

During the past year, market requisitioning has been pilot tested and implemented, and central stores inventory procedures have been modified to accommodate delivery by sector. This latter change has assured point to point delivery within two days of stock requisition entry with an ultimate goal of 24 hour delivery.

A great deal of staff time was spent in providing design requirements to the DHHS Financial/Administrative Integrated Management System (FAIMS) project. The months of January, February, and March, 1985 were dedicated to this effort and nine volumes of the latest ADB documentation were turned over to the FAIMS project team on April 9, 1985.

DMB staff also has spent several weeks attending IDMS-DB/DC classes in anticipation of a successful Cullinet effort on the FAIMS project.

The Clinical Information Utility (CIU) is a long-term effort designed to provide a unique archive of integrated data for use in patient care and research. This year a research data entry, extraction, and formatting system was developed that integrates data from the Clinical Center's Medical Information System (MIS) and the CIU and permits online edit and collection of data specific to clinical trials. Currently there are six users of this system.

Using DMB's experience with the CIU, a system has been developed to improve NIADDK's Phoenix clinical and field studies efforts. The Phoenix Clinical Information System (PCIS) brings together a diffuse set of field and clinical data to support current and future research studies. Using this new system, a researcher can select potential populations for specific studies and collect, control, and analyze new data using a single data base service.

In an NHLBI effort to enhance the retrieval and analysis of the combined cardiology/cardiac surgery data bases, a conversational statistical analysis system was developed. This effort required the summarization and interpretation of stored results into a highly structured data base, and the development of a user-friendly means of statistically manipulating heart valve replacement data. As developed, the system provides a good base for expanding analysis to all data base variables and prospectively can be adopted for use in other research studies.

Before we did this work, the data base used for retrieval comprised of raw data points listed in chronological order.

Whenever an investigator asked a non-raw data oriented question, DMB had to interpret/summarize the raw data and create a subfile from which NHLBI could actually respond. This required an extra step in each retrieval, as well as constant assistance by DMB.

From NHLBI's and our experience, we were able to identify common uses of the data bases that caused us to create subfiles prior to retrieval or analysis. We also identified other types of retrievals that actually required follow-on hand calculating.

In addition we selected the critical data elements required for retrieval and analysis.

From this analysis we developed a fixed length record for the new data base that contained commonly retrieved data elements, interpretations of raw data, and summary information about the raw data. Examples of these interpretations and summaries are: identification and summarization of redo operations by type, menu deviation between operation and complication, menu valve area on success/fail valves, and examination of coded data to identify congenital heart disease.

This new data base now is used for almost all retrieval, analysis and graphics processing. The NHLBI does most of this processing using online conversational programs; it requires little DMB involvement.

Other important projects in which DMB has been involved are too numerous to highlight here. Please refer to the DCRT *FY85 Annual Report, Volume 2* for these reports.

Future Plans/Trends

Initial agreements with the Office of the Secretary, DHHS augured heavy DMB involvement in the development and implementation of FAIMS. Due to what appear to be contractual conflicts, DMB involvement has been limited to providing design requirements for FAIMS, and Cullinet will have full responsibility for FAIMS development and implementation.

When Cullinet provides its design proposal for FAIMS, DMB will provide assistance to NIH functional managers in the iterative process of design review, change, and final design. Once the design is finalized, DMB will provide assistance to NIH functional managers in developing system acceptance test criteria and acceptance test cases. Cullinet will test its software directly with the functional managers and DMB will assist the functional managers as they review acceptance test results.

Two new challenges that will be addressed in detail during the next fiscal year are the review of options for relational data base processing and the examination of the potential for more general use of personal computers.

Relational data base processing offers: the potential for optimizing online processing of management information stored on large data bases such as the

ADB; the possibility of eliminating a high percentage of data processing redundancy and hard copy reporting; and the facility for online data collection, retrieval and analysis for more general use in data processing applications.

DMB efforts in this area will concentrate on analyzing the efficiency and effectiveness of presenting large data bases to the NIH community for processing management information, and using the relational software as a comprehensive solution to data collection, storage, retrieval and analysis of common NIH problems. The ADB will be used in FY86 to test the large data base management information solution.

Personal computing has been highly recommended by its vendors as the solution to many, if not all, of the information processing problems of the past. It is the DMB view that personal computers offer an excellent supplement to existing computational facilities and they can solve some of the information handling problems that users have had in the past.

The broad questions that must be answered are: What problems are best solved at the personal computing level? Where do personal computing efficiencies begin and end? How can the personal computer be used to supplement the facilities available on the mainframe?

DMB has selected a project to test the local and network facilities available on personal computers along with the mainframe interfaces that best supplement them. This project recently has begun, and we should be in a position to discuss results and recommend personal computing approaches during the coming fiscal year.

As a supplement to the personal computing project, we also will be examining alternatives to the manual and automated collection of data on personal computers for the Epidemiology and Field Studies Branch, NIADDK, in Phoenix, Arizona. This problem is particularly interesting because of the telecommunications difficulties that exist among the Sacaton reservation, the Phoenix field studies office, and the Computer Center in Bethesda.

Publications

Cole, B.R., and Goldberg, R.N.: Bright: Development of a Friendly, Interactive, Self-Teaching System for Analysis of Clinical Research Data. ASA-IASC-SIAM Conference on Frontiers in Computational Statistics. October 22-24, 1984.

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POSTER, created by Steve Bailey and John Dickson for the DECsystem-10, is a text processor for producing cost-effective display type for posters, slides, and similar artwork.

The reversed copy below features newly-designed character fonts recently incorporated into POSTER. Characters fill in automatically and solidly, leaving no unshaded areas regardless of font size.

▸ DECsystem-10 Hardware

- Third KL10 Processor Added
- Memory Upped to 2.5 Mwords
- More File Storage Capacity

▸ DECsystem-10 Software

- New 7.02 Operating System
- ANSI Standard FORTRAN 77
- C Compiler Introduced

▸ IBM System 370 Hardware

- New Magnetic Tape Subsystem
- Online Disk Storage Increased

▸ IBM System 370 Software

- Information Exchange Introduced
- New MVS/XA Operating System
- New Version of TELL-A-GRAF

Computer Center Branch

Joseph D. Naughton, Chief

Function

The Computer Center Branch--the largest component of DCRT--designs, implements, operates, and maintains the NIH Central Computer Utility and its associated telecommunications facilities. To insure the most effective use of the Utility, the Computer Center staff conduct a formal training program for computer users, write and publish technical documentation, and provide programmer assistance and consultation on the use of the Utility in support of scientific and administrative programs at NIH. Chartered as a Federal Data Processing Center, the NIH Computer Center also provides data processing services, on a cost-reimbursable basis, to authorized users from agencies throughout the Federal Government.

The NIH Computer Utility consists of two multicomputer facilities designed around large-scale IBM and DEC mainframe processors. The facilities are linked together by high-speed telecommunications lines and connected by telephone lines to thousands of remote interactive terminals and microcomputers located at NIH and other Federal agencies throughout the United States. Complementing the systems hardware is an extensive array of software that has been designed and implemented by Computer Center personnel or acquired from other sources and adapted to meet the unique needs of NIH.

The Computer Center employs a highly specialized staff of professional, technical, and management personnel to ensure smooth functioning of the NIH Computer Utility 24 hours a day, 7 days a week. Operating systems software is developed and maintained by a staff of computer systems programmers and analysts, who also provide technical consultation on program design and problem resolution, teach training courses, and write technical documentation describing the effective use of the Utility.

The Computer Utility's hardware and telecommunications networks are operated and maintained by computer system technicians and operations personnel, while the data conversion services are provided by a staff of data entry personnel. Systems design and management professionals are responsible for long-term program goals and the design integrity of the Utility. Because the Computer Center receives no appropriated funds from Congress, all services of the NIH Computer Utility are performed exclusively on a fee-for-service, cost-recovery basis.

The Computer Center also conducts a number of research and development projects to increase the effectiveness of computers in support of modern biomedical research. Current research and development projects include development of facilities to enable microcomputers to be used in conjunction with the Utility; enhancement of output devices to permit high-quality display mathematics; installation of a relational data base management facility; linking of the Computer Center to international Value Added Networks; and the integration of high-speed array processors into the central Utility.

Scope of Activities

The two interconnected digital computer facilities of the NIH Computer Utility provide timesharing, data base, graphics, batch processing, and word-processing services to over 17,000 authorized users. The IBM System 370 facility is designed around five IBM 3081 and one 3084 processors (CPUs) with a total of over 224 million bytes of directly addressable memory. The peripheral complex include 474 online disk drives with a total data storage capacity of over 300 billion bytes and two mass storage units with a combined capacity of 401 billion bytes; 109 tape drives with a transfer rate of 780KB/sec each and six at 200KB/sec tape drives; seven 18,000 line-per-minute and five 1,100 line-per-minute page printers; two 1,000 card-per-minute card reader/punches; and 13 telecommunications controllers supporting a teleprocessing network with the ability to service over 1,400 concurrent users.

The IBM facility is complemented by a DECsystem-10 facility designed around three KL10 and one KS10 processors with three million words of main memory; twelve 554 megabyte disk drives and nineteen 197 megabyte disk drives; six 780KB/sec tape drives and three 200KB/sec tape drives; and eleven communications processors capable of supporting over fifty simultaneous timesharing users.

The two computer facilities are interconnected by telecommunications facilities and are linked by standard telephone lines to thousands of interactive terminals and microcomputers as well as 268 remote job entry (RJE) computers located throughout the United States. Ancillary equipment includes two computer output microfiche units and film processors, two four-color high-resolution plotters, and miscellaneous other devices.

Three interactive programming systems and a large interactive data base management system are available through the NIH Computer Utility. These are DECsystem-10 timesharing, TSO, WYLBUR, and IMS. Over 85 percent of all commands are executed with subsecond response time. There are four classes of batch jobs (one small, two medium, and one large), with respective turnaround times of less than 30 minutes, one hour, two hours, and overnight.

Programming languages include FORTRAN, COBOL, PL/1, BASIC, Assembly Language, PASCAL, SAIL, and SPEAKEASY. A variety of statistical analysis, modeling, and utility programs are available, as well as the DISSPLA, TELL-A-GRAF, POSTER, and OMNIGRAPH interactive graphics packages for generating graphic output on paper or microfiche.

Users of the Computer Utility are informed of programming standards, available services, and facilities through two comprehensive manuals, the *Computer Center Users Guide* and the *DECsystem-10 Timesharing Guide*. Changes in the utility are announced through *INTERFACE*, a periodic technical newsletter, which published seven issues this year. An in-house training program offered classroom lecture service to 3,600 students, and interactive, computer-aided instruction was utilized by 3,000 users this year.

Highlights of the Year's Accomplishments

Today the Center serves over 17,000 active users and processes 18,000 batch jobs, 11,000 interactive sessions, and 50,000 data base transactions each work day. A steady increase in the demand for services continues to be a dominant feature. To accommodate this increase, major improvements were made to both the DECsystem-10 and the IBM System 370 facility this year. New processor and peripheral devices together with significant software changes greatly increased the processing capacity of both systems.

The largest single expansion of the DECsystem-10 in many years provided significant increases in program execution speed, response time, and system reliability for users. The DECsystem-10 received a new operating system and an additional processor, as well as upgrades on the existing processors, memory expansion, and faster disk drives.

After months of testing and intensive work to adapt it to the unique requirements of the NIH user community, the new version (7.02) of the TOPS-10 operating system became the production monitor on the DECsystem-10 at the NIH Computer Utility. The new monitor offers a number of significant enhancements to both job management and disk I/O processing. It provides more room for data tables within the monitor, improving the ability of the system to handle large numbers of simultaneous jobs; and it allows more space for data that the TOPS-10 uses to access files, which greatly increases the speed and efficiency of disk I/O.

The addition of a third KL1091 CPU to the two already in the system provided a 50 percent increase in processing power and greatly enhanced system reliability since it is now possible for two CPUs to remain in operation in the event that one fails.

Six new RPO7 disk drives were added, increasing user storage capacity by 40 percent and providing a higher data transfer rate to ensure maximum performance of the disk file system. Eight new MH10 memory units, which each contain 256K 36-bit words of memory, also were added to the system, allowing the removal of the four remaining MG10 memory units, which have proved increasingly unreliable during the past few years. The new memory units increased the real memory capacity of the NIH DECsystem-10 by 150 percent, to 1.5 megabytes.

A major enhancement to the operating system of the IBM System 370 became operational this year. The transition to IBM's new MVS Extended Architecture (MVS/XA) took place over much of FY85 and has resulted in significant increases in virtual memory capacity, internal operating efficiency, and system reliability. MVS/XA introduced 31-bit addressing, which expands the amount of virtual memory available to 2 billion bytes, representing an increase of 128 times. Extended Architecture also balanced channel load and the distribution of job queues, improved response time, and allowed fewer outages, better error detection and recovery, and increased ability to support new functions, devices, and users in the future.

The changes necessary to incorporate MVS/XA into the NIH Computer Utility were accomplished without service interruption. Portions of the MVS Operating System were modified and new positioning products were installed and tested throughout the year. Over 65 NIH written functional enhancements to the Job Entry Subsystem (JES2) were rewritten and redesigned to accommodate MVS/XA. These modifications accounted for more than 25,000 lines of source code. Numerous software products were converted and tested for compatibility with XA.

After considerable internal integration and simulation testing, a two-phase user test program was initiated to enable users to test their application programs under MVS/XA while the old MVS system remained available as a backup. At the end of the production testing period, MVS/XA became the standard production operating system of the IBM System 370, and the old operating system was permanently removed.

The efficiency and economy of the NIH Computer Utility was demonstrated once again this year as the Computer Center announced rate reductions for services on both the IBM and DECsystem-10 facilities, making 1985 the 18th consecutive year of steadily declining rates.

On April 1, the processing rate on the IBM system was reduced 6.25 percent from .32 to .30 per machine unit for all classes of batch processing work. The cost of public online disk storage space also was reduced, dropping 5 percent to .02 per track per day. This makes the use of online storage by batch and teleprocessing systems even more attractive.

The expansion of the DECsystem-10 was accompanied by even more striking reductions in rates. Rate reductions were announced twice during the year. In October, a full 25 percent reduction in the charge for connect time brought the cost of maintaining a telephone connection to the computer down to 1.50 per hour. The processing charge was lowered 15 percent from .92 to .78 per machine unit. This charge was reduced even further in April to .74 per machine unit, a five percent reduction. A two-step reduction also occurred in the cost for online data storage. The long-time fee of .10 per hundred blocks per day was lowered ten percent in October to .09 and an 11 percent cut in April brought the new rate to .08 per hundred block days.

The discount period for night processing on the DECsystem-10 also was increased by three hours per day, giving users an additional 15 hours each week in which they can save 60 percent of all processing costs. The night discount now applies to all work processed between 5 p.m. and 8 a.m. Monday through Friday and all day on weekends and holidays.

Increased system utilization has been a significant factor in rate reductions for many years. As operating budgets and personnel ceilings are reduced, users continually develop new computer applications to keep pace with mission requirements. The rapid response time and quick batch turnaround of an efficient and highly-tuned system like the NIH Computer Utility permits much work to be done in a short period of time; and because computing costs are increasing at a slower rate than workload, steadily declining rates are possible.

Future Plans

Procurement and implementation of a new tape drive technology will be a major goal for the coming year. The new tape system, called the IBM 3480 Magnetic Tape Subsystem, will substantially improve performance, increase reliability, and reduce costs for all jobs using magnetic tape. The 3480 features a small cartridge that completely encloses 500 feet of half-inch mylar tape with a chromium dioxide coating; it is a radical departure from current tape technology that uses an open 10.5 inch reel holding 2400 feet of mylar tape coated with iron oxide. Because the 3480 is able to record data more than six times as densely as current technology allows, each compact cartridge is capable of storing about 20 percent more than a traditional reel of tape. The tape drive itself also is much smaller, allowing the amount of floor space devoted to the tape library and tape drives to be reduced by about 60 percent and it reads or writes data at more than three million bytes per second, twice as fast as current technology allows. In addition, the completely enclosed cartridge reduces errors and simplifies operator handling.

Another important goal for next year is to extend the VSAM testing service initiated in 1985 to large production applications. When the testing begun in 1985 is completed, the limited VSAM support will be extended to provide a fully supported VSAM service for all applications. This will permit users to convert existing critical applications systems to VSAM, as well as allow the installation of new software products that require VSAM for proper operation.

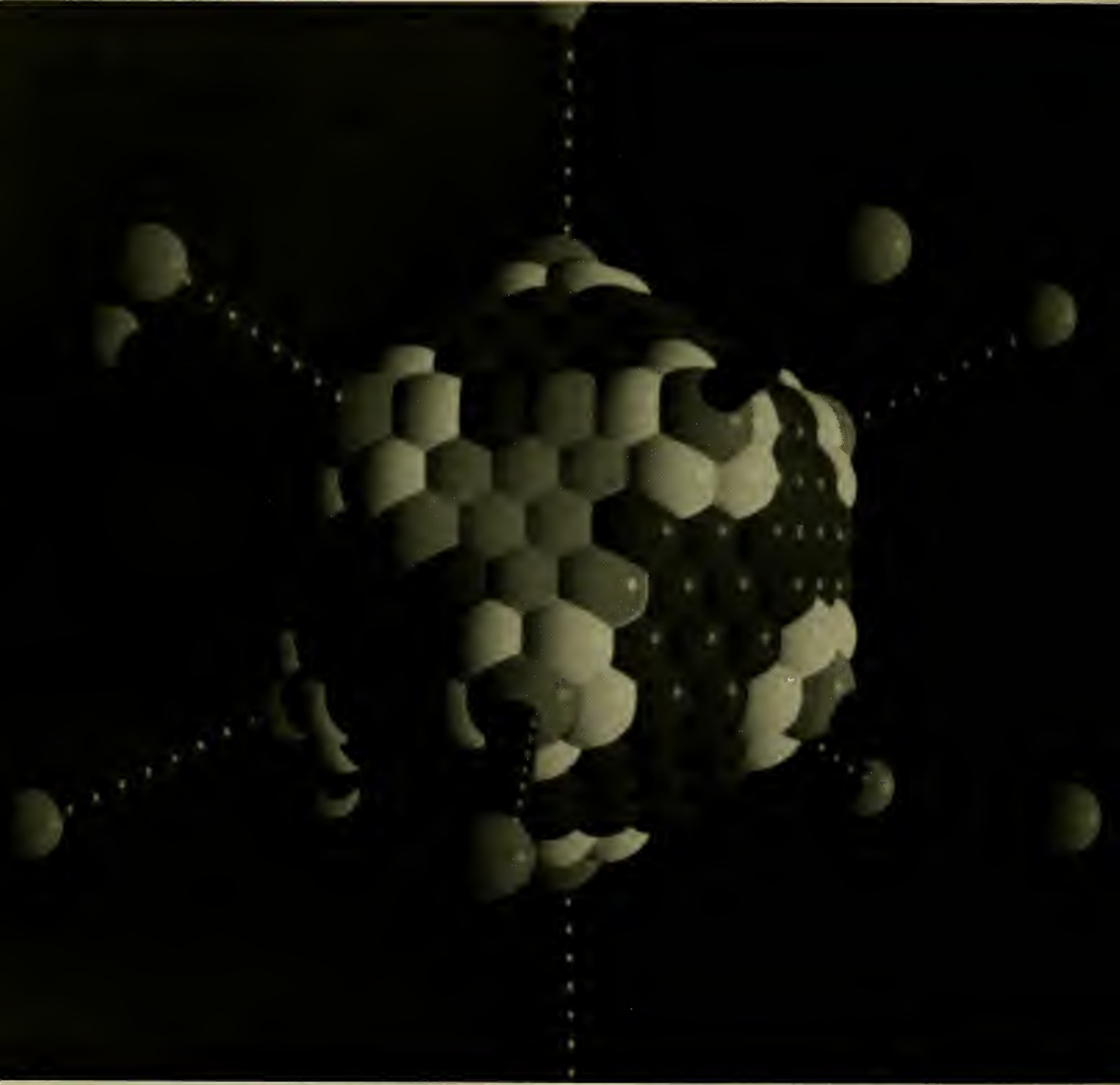
Other development projects planned for 1986 include: services to facilitate the use of microcomputers in collaboration with mainframes, enhanced hardware facilities for vector mathematics, and the installation of user-friendly data base systems. Developing procedures to support the use of microcomputers at NIH will continue to be an important priority of the Computer Center. Improved file transfer services and a terminal emulator package will be provided for microprocessor users. An array processor to facilitate processing of large scientific problems involving matrix mathematics will be procured and integrated into the IBM system, and a new data base system that supports both mainframes and microcomputers will be considered for installation in 1986.

Further developments in printing facilities will facilitate the printing of high-quality documents containing scientific notation, and work will continue on connecting the NIH Computer Utility to a public communications network to minimize communications costs for long distance users.

Richard J. Feldmann uses a computer system that converts data obtained by x-ray crystallography and other means into images in which atoms are simulated in perspective and color coded.

Structures containing up to 10,000 atoms can be depicted and manipulated.

This is an adenovirus from electron micrograph data.



Office of the Director

Arnold W. Pratt, M.D., Director

Function and Scope of Work

The Office of the Director provides overall program and management direction for DCRT. The Director, Deputy Director, Assistant Director and Executive Office work together as the immediate Office of the Director. There is also an **Equal Employment Opportunity Office** and four offices whose activities supplement the work of the DCRT laboratories and branches:

- **The Personal Workstation Office** (PWO) provides guidance and technical assistance in the effective use of personal computers at NIH.
- **The Office of Administrative Management** (OAM) provides administrative and managerial support for the work of DCRT. OAM includes the Administrative, Personnel, Financial Management, and Project Control Offices.
- **NIH ADP Policy Office** (NAPO) is the central NIH focus for advice and assistance on matters related to complex policy and procedures governing the procurement and management of computers in the Federal Government. It serves as the point of contact on these matters with Federal agencies outside of NIH.
- **The Office of Scientific and Technical Communication** (OSTC) serves as a central source of information about DCRT activities and about computing and related disciplines. It includes the DCRT Information Office and the DCRT Library.

In addition, the Office of the Director sponsors several research and development projects including the Molecular and Cellular Graphics Project.

FY85 Accomplishments

The Director and Assistant Director continue to represent DCRT on the DHHS Information Resources Management (IRM) Advisory Board. The Deputy Director joined them in February and worked through revisions of the old *DHHS ADP Systems Manual* and a new *Handbook for Strategic IRM Planning.*

Dr. Bernard Brooks joined the Molecular and Cellular Graphics project this year as a staff fellow. In addition to his research contributions, he taught a course in the theory and usage of CHARMM (Chemistry at HARvard Macromolecular Mechanics) at NIH.

The course covered energy minimization, dynamics simulations, and setting up needed data structures. It also introduced advanced topics, such as vibrational analysis, Langevin dynamics, and the interface of CHARMM with external graphics programs such as XRAY and PLT2.

Activities and plans of the four OD Offices follow in this volume. Office of the Director research work is described in detail in Volume 2 of this *Annual Report.*

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Personal Workstation Office

David C. Songco, Chief

Function and Scope of Work

The Personal Workstation Office (PWO) provides guidance and support to scientists and administrators throughout NIH in the effective use of personal workstations and associated automation technology. Specifically, it provides technical assistance, training, and publications on relevant hardware, software, and overall personal workstation architecture. In conjunction with other DCRT labs and branches, the PWO collects, develops, and distributes software of general use to the NIH community. As part of its training and consulting function, the PWO operates user resource centers. The PWO works closely with the DCRT labs and branches to monitor the rapidly changing technology and the technical requirements of the user community in the area of personal workstations and the associated interfaces to the NIH Computer Center, so that these needs are reflected accurately in the development and support provided by DCRT.

Fiscal Year 1985 Accomplishments

The establishment of the B/I/D Lead User Program was one of the first accomplishments for FY85. B/I/Ds nominated individuals to serve as the first level of support for personal computer users within their organizations. The PWO provided intensive hands-on training for the lead users covering the full range of supported hardware and software. Now over 130 lead users are available to their B/I/Ds to train other staff members, field questions and determine solutions or forward them to the PWO, and to communicate information to the user community. The PWO serves as the focal point of this support system and is backed up by experts from within DCRT.

"Working groups" of lead users were established to concentrate on specific areas such as data management, spreadsheet applications, integration of office automation and PC technology, laboratory applications, graphics, and telecommunications. These groups meet regularly and provide a means to select, test, and evaluate new technology. They also serve as an information exchange between DCRT and the B/I/Ds, and identify and explore relevant PC issues for users in the B/I/Ds.

The NIH User Resource Center (URC) was opened in January 1985. This multipurpose center is a joint program by DCRT, the Division of Personnel Management (DPM), and the Division of Management Policy (DMP). The URC is used for training, user consulting, demonstrations of new technology, individual practice, and self-instruction related to personal workstations and associated technology.

A series of six intensive hands-on courses covering the DCRT-supported architecture for operating systems, text editing and word processing, data management, data analysis, and telecommunications were presented in the URC to B/I/D lead users representing more than 30 organizations at NIH. The PWO also offered 11 different courses through the regular DCRT training program. An average of 2.7 hours of classroom instruction per day was provided to over 1900 registered students. Instructors for the lead user series and the DCRT lectures were drawn from the PWO and from other DCRT labs and branches.

Vendors provide additional onsite microcomputer training at the URC. The PWO serves as technical consultant to DPM in the selection of vendors and course material. This collaboration ensures that both compatibility and support issues are considered in the selection of courses to be offered to the NIH community. The combined totals for microcomputer training offered by DCRT and DPM in FY85 show 105 total classes and 945 hours of classroom instruction, with 2,450 students registered for a total of 20,000 cumulative student hours of instruction.

In addition to answering requests for assistance by telephone, the PWO provided technical guidance and consulting in the URC for NIH scientists and administrators who experienced difficulties using the personal workstation products supported by DCRT. The problems presented varied from information on elementary use of products to complex technical considerations. PWO staff worked with the user to diagnose the causes of problems and present solutions in clear terms. As part of this process PWO staff referred clients to specialists in other DCRT labs and branches, and called upon B/I/D lead users to present demonstrations and assist in the consulting process.

Telephone and walk-in requests for assistance increased over the year, with several hundred requests processed each month.

The PWO worked with the Computer Systems Laboratory (CSL) and the Data Management Branch (DMB) to investigate Local Area Network (LAN) technology as it relates to personal workstations and associated technology. The DCRT Ethernet LAN was installed in early FY85. Over 50 personal workstations have access to this LAN. The collaborating groups are developing and testing enhancements to the network. This experience forms the basis for providing guidance to other NIH organizations interested in interfacing personal workstations via local area networks. As part of this service, representatives from PWO, CSL, and DMB provide regularly scheduled seminars on this rapidly emerging technology.

Future Plans/Trends

The lead user training series will be offered twice a year: once in the Fall and once in the Spring. New candidates for lead users will be phased into the support program by this process. The DCRT microcomputer lecture series will continue for the products supported by DCRT. PWO staff will work with individual B/I/Ds to establish a structured user support system within the B/I/D. This process has already begun at NCI, NLM, NIA, and NHLBI. A pilot, vendor-taught Office Automation Implementation course has been developed in conjunction with DPM and DMP. This course will be offered to the NIH community in FY86.

User consulting will continue with the addition of online tracking and more scheduled seminars on topics of general interest. To augment the consulting process, online selective retrieval of technical reports, descriptions of supported hardware and software products, procurement information, and miscellaneous information acquired from applications within NIH will be available online from the NIH Computer Center.

The collaborative LAN project with CSL and DMB will continue. New technology such as the IBM PC LAN and Token Ring architecture will be evaluated and integrated into the DCRT LAN based on the results of the evaluation. A smaller LAN will be established in Building 31 for DCRT staff located there.

Office of Administrative Management

L. Lee Manuel, Chief

Function and Scope of Work

The Office of Administrative Management, under the direction of the Executive Officer, handles a broad range of administrative managerial functions for an NIH research division of over 300 people. The office serves as liaison between these functions and the NIH Office of Administration, Office of Research Services and with other NIH, PHS, and DHHS offices. It consists of 17 people (6 temporary or part time), organized functionally into three sections: finance, personnel, and administration.

The **Financial Management Section** supports general budgeting and accounting activities for the Division. It also manages the detailed accounting for the use of DCRT computing and programming services and provides detailed billing information to the users of these services.

The **Personnel Management Section** supports Division work under the many varied and ever changing requirements of the several Federal Personnel Systems used at NIH.

The **Administrative Management Section** provides primary assistance to the Executive Officer in the overall planning, direction, coordination and execution of the administrative aspects of the Division's program and actively participates in administrative program planning, policy making, and in the resolution of operating problems.

Fiscal Year 1985 Accomplishments

The Budget Office continues to carry out annual budget functions for the Division. In addition to normal budget formulation and execution, it produced management reports for the DCRT Office of the Director, laboratories, and branches. The Office also participated in setting and reviewing rates for Service and Supply Fund data processing activities.

The reporting system has proved to be a valuable management tool. Transfer of many of these reports to a personal computer increased the timely availability of the Division's financial data. The need for even more detail by the Lab/Branch Chiefs will result in modifications.

The Project Accounting Staff processed requests for new accounts and registered new users. More than 1,000 users and 100 accounts were added to the accounting system in FY85, even though DCRT had to place constraints on adding new users from outside NIH. They successfully completed the major annual update of information on over 17,000 users and 3,000 accounts. Several modifications, including the elimination of some reports, were made to the Project Accounting System.

A new sponsor data base system was implemented. This is an index by both account number and account sponsor that is part of the user registry system. It enables the system to provide online access to information on each account such as sponsor's name, location and phone number, as well as a listing of all users on the account.

The DCRT Personnel Management Section recruitment activity was hampered by a reduction in NIH FTEs for FY85. Our reduced position ceiling resulted in less recruitment. In spite of this decline approximately 1,500 personnel actions were processed, ranging from promotions to separations.

A long standing and complex employee complaint was negotiated for settlement to the satisfaction of all parties. The Performance Management and Recognition System was implemented for FY85. As part of an NIH initiative, the DCRT personnel office conducted a position review for assignment of "competitive level codes" for all occupations in DCRT to determine the retention standing of employees for purposes of reduction-in-force.

The Administrative Management Section processed the variety of procurements to acquire approximately 30,000,000 in supplies and equipment for DCRT during FY85. Day-to-day management activities conducted by this staff included: procurement purchases and contracts; processing of travel and training requests; administration of property, space and communications; payroll; and mail/messenger.

The DCRT Executive Officer also coordinated the preparation of the *Annual Research Plan* and represented the Division within OD, NIH, as Program Planning Officer. He also served the Division as its international representative to the Fogarty International Center and as its legislative contact with the Division of Legislative Analysis, OPPE, NIH.

Future Plans/Trends

The OAM will continue its efforts in providing administrative management support to the Division's programs.

Working with the PWO staff the Administrative Office staff will conduct pilot studies on the Personal Computer to determine if the PC can replace the 3270 type terminals for Delpro access as well as generate or complete the numerous types of forms used in the procurement process, travel, training and property areas. Also, assessment will be made to see if a newly installed DCRT Local Area Network can be useful for document transmission.

NIH ADP Policy Office

James V. Oberthaler, Chief

Function and Scope of Work

The NIH ADP Policy Office (NAPO), under the direction of the Assistant Director of the Division, has four closely related functions:

1. It serves as a focus for NIH-wide coordination of Automatic Data Processing (ADP) policy matters.
2. It serves as a central NIH point of contact with the Public Health Service, Department of Health and Human Services, other HHS agencies, and the General Services Administration on policy and regulatory questions.
3. It provides the point of contact for those NIH procurement and contracting matters that must be cleared by DCRT prior to procurement or contracting action.
4. It also provides advice and assistance to NIH staff and others concerning the internal operations of DCRT in matters of ADP policy and procurement.

The activities of the Office include:

- advising the Director of DCRT and, through him, the Director of NIH on ADP policy matters
- reviewing and evaluating proposals from NIH B/I/Ds for procurements and contracts related to computing and ADP
- directing the development of the annual*NIH ADP Plan*
- assisting the NIH Division of Management Policy on questions relating to its responsibility for administrative and management computer applications
- representing NIH in PHS and DHHS policy formulation efforts
- working with DHHS and GSA staff to obtain necessary approvals for NIH on procurements and contracts, and
- answering inquiries from scientists and administrators who are confused by the whole process.

FY85 Accomplishments

During the year, this office reviewed nearly 3,500 proposals for acquisition of ADP equipment and/or services and commented on approximately 40 research contracts involving ADP. Each was reviewed to ensure that it was justified and was in conformance with PHS, HHS, GSA, and OMB guidelines.

NAPO continued to be available to advise and guide the NIH community on proposed and modified ADP systems. It also provided leadership and a focal point for NIH responses to requirements from DHHS, GSA and OMB; improved and simplified clearances for some ADP procurements; and gathered materials for inventories and reports on ADP systems.

An interactive data base and communications system was developed for the Office of Intramural Affairs (OIA). This system provided the NIH Scientific Directors with indexed remote access to the minutes of the file of meetings of the Board of Scientific Directors and facilitated electronic communication of documents to the Scientific Director. Concurrent with this development was the training and support of OIA staff for office automation including word processing, telecommunications, and the development of automated systems for tracking personnel actions.

NAPO sustained its active role in the development and structure of the Personal Workstation Office by providing a degree of NIH-wide training support and participating in the PWO Steering Committee.

As general support of ADP at NIH, staff members of the Systems Planning Section provided direct assistance or ADP advice to an average of 150 callers or visitors per month. Contacts frequently involved questions associated with ADP procurement clearances and procedures, requests for technical assistance with commonly used software packages, and advice on the availability and efficacy of a variety of NIH ADP facilities for B/I/D applications.

The Policy Coordination Section conducted risk analysis of five major application systems, three small facilities, and the entire DCRT Computer Center facility. Additionally, the section continued its efforts toward acquiring security clearances for key ADP personnel, coordinated the IRM Strategic Planning Process with DHHS staff, developed the FY87 Information Technology Systems (ITS) budget, upgraded the PHS inventory data base system, and evaluated several personal computer security packages.

Future Plans/Trends

The Office anticipates major structural changes in the first quarter, to help ease the growing workload and to best serve its NIH constituency. Significant resources will be devoted to establishing policies and guidelines for IRM implementation DHHS-wide.

Office of Scientific and Technical Communications

William C. Mohler, M.D., Chief

Function and Scope of Work

The DCRT Office of Scientific and Technical Communications (OSTC), under the direction of the Associate Director, DCRT, includes:

- the **DCRT Information Office,** which is responsible for a comprehensive information program directed toward a variety of audiences within and outside NIH. The program is addressed to those whose needs and attitudes have important bearing upon what DCRT strives to accomplish; and
- the **DCRT Library,** which maintains a special collection in computer science, mathematics, and statistics, along with computer applications in biomedical science, engineering, information science, and management. Information resources and services support the activities of DCRT staff and other NIH personnel. Members of the public may use the Library collection on the premises.

FY85 Accomplishments

As in previous years the Information Office devoted a large segment of its limited resources to developing and producing publications that together present a comprehensive view of the many activities within DCRT. This year these included the *1985 Annual Report,* two new editions of *Computing Resources,* several reprints and revisions of brochures, and a directory of computer-based image processing facilities and projects throughout NIH. Over 8,000 publications were distributed.

There were over 2,000 substantive requests for information this year, primarily from NIH staff, and secondarily from the general public, including queries from reporters representing publications as diverse as *Newsday, Spaceworld, Government Computing News, Town and Country,* and *Business Week.*

In support of direct communications involving DCRT staff, the Office coordinated the last two events of DCRT's 20th anniversary year--a three-day Biomedical Computing Symposium and the LSM open house. IO staff arranged a three-day meeting, Rate Processes and First Passage Times in Chemical Physics, and assisted CSL participants with PHS's Engineering Day presentations.

Visitors who came to DCRT for briefings and tours included groups from the annual Symposium on Computer Applications in Medical Care, the Congressional Office on Technology Assessment, and from China and Cuba.

The Office provided computer typesetting advice and assistance to NIDR for its annual report, and to the Office of the Director, NIH, for the *NIH Scientific Directory/Bibliography,* involving several consultations with GPO and OD/NIH staff. Research was begun on using a personal computer as an input device to create computer processable files compatible with GPO's Automated Composition System.

Other activities included holding another Effective Technical Writing course for DCRT staff and adding a personal computer workstation to the office.

The Information Officer served on the faculty of the STEP Module, giving an overview of DCRT to NIH extramural staff, and also served as technical reviewer on NCI contract proposals for conference support.

The DCRT Library also had a busy year. The staff continued its work in FY84 to automate library operations making use of both general purpose software and commercial library application programs. The Library's two microcomputers now are actively used in acquisitions, cataloging, circulation, online searching, serials control, interlibrary loans, word processing, and the automation of more and more management records and statistics.

The Library is the heaviest user of the relatively new DCRT ETHERNET. Library data are centralized on a network file server for access from both of the Library's computers. This has eliminated some severe queuing problems at the keyboards. Starting in August, the Library established a news board on the ETHERNET. This alerts users in DCRT about files they may peruse on the ETHERNET, as well as news of Library activities.

Beginning in February, library users could receive their monthly acquisitions list announcements via DEC MAIL, WYLBUR MULTMAIL, INFORMATION EXCHANGE, or ETHER MAIL. They also can use these various systems to request specific titles. User response has been very enthusiastic.

The Library became increasingly involved in DCRT and NIH personal workstation activities. In addition to controlling the circulation of 234 publications for the DCRT Personal Workstation Office (PWO) and NIH Lead Users, the Library now orders these items. The Librarian has met with representatives of the User Resource Center to coordinate collection building and resource sharing. Other topics covered included referrals and retention policies. The Library Technician represented the Library on the Lead Users Group and on its DBMS Special Interest Group, as well as demonstrating DBASEIII at introductory classes and assisting in DBASEIII classes. The Librarian assists PWO staff with inquiries on bibliographic file manager packages.

The Library carried on its basic operations and services at an increased level. In FY85 circulation was up about six percent over FY84. The collection now contains some 7,000 books and technical reports and 250 journal subscriptions. There are almost 1,000 registered active borrowers throughout NIH.

Online bibliographic searching increased by 43 percent. The Library can search a wide range of online bibliographic data bases for DCRT employees. There was also a 60 percent increase in staff requests for interlibrary loans. Nevertheless the requests for loans from DCRT still far exceeded the number of requests that DCRT made to other libraries.

The Library cooperated with other libraries and information centers by sharing resources. This was accomplished through formal organizations such as Interlibrary Users Association (IUA) of the Washington-Baltimore Area, the Metropolitan Washington Library Council, FEDLINK (the federal library community's consortium), and, at a national level, the Online Computer Library Center (OCLC) network.

The Librarian and Library Technician demonstrated library applications of DBASEIII and File Transport Package in November at the Federal Interagency Field Librarians' Workshop. The Librarian was a panel member disucssing local area networks at the Joint Spring Workshop: Office Automation and Library Productivity. She completed her term as President of the second largest chapter of Special Libraries Association, and will serve one year as Past-president of this 900-member organization.

Future Plans and Trends

The Information Office is working to improve the quality of materials produced to describe the Division's activities and their accomplishments. Greater emphasis will be placed on videotape productions. A market researcher has been contracted to help analyze how well these communications meet the needs of NIH staff for information about DCRT activities and computing in biomedical research.

Heavy involvement is expected in the next fiscal year for special events such as the NIH Centennial celebration, MEDINFO 86 opening ceremonies, and an exhibit for the Minority Biomedical Research Symposium.

Both public speaking and technical writing courses will be offered early in the next fiscal year. Additional work is planned on personal computer applications for public affairs offices, particularly in computer typesetting.

The Library forsees further consolidation and sophistication in the use of microcomputers. This will expand its capabilities, as well as reduce the clerical workload. The Librarian has reviewed six library applications packages for online catalogs; a choice has not been made. A selection is hoped for soon, one that can be available on the ETHERNET and/or dial-access. The catalog file has been created in machine readable form, but requires de-duplication and elimination of cancelled records. Due to the size of the libraries files, the Library has been advised to install its own fileserver on the net.

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